A PRELIMINARY SURVEY OF THE WATER BEETLE FAUNA OF GLEN JULIA SPRINGS, FLORIDA [1]

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The water beetle fauna of most of the larger springs in Florida is disappointingly meagre. Often only a few common species can be collected after intensive search, or a few species of Gyrinidae flood the surface with great schools. When a spring in fairly natural condition can be found the smaller beetles are mostly representative of the stream fauna of the area; and occur only along the edges in protected backwaters or similar situations. In consequence, the writer was pleasantly surprised at the diversity of habitats and the richness of the water beetle associations found at Glen Julia Springs near Mt. Pleasant in Gadsden County, Florida.

The collections from the Glen Julia Springs area were not confined to a single main boil and the resulting run, as is necessary in the case of most large springs. The richness of the fauna thus reflects the occurrence of specialized situations which have either not been found in other areas, or which occur in such small patches that they are unable to support characteristic associations. The occurrence of several rare or relict species emphasizes the importance of the concept of minor habitats, the "niches écologiques" of Paulian (1948), and may have very broad implications in regard to the supposedly relict fauna of this region of Florida and southern Georgia and Alabama.

The Glen Julia Springs issue from the sides of a ravine about 50 feet deep. The resulting small stream flows eventually into South Mosquito Creek, a tributary of the Apalachicola River. The head of the ravine where collections were made is surrounded by an extensive area of Norfolk sandy loam (Fippin and Root, 1903). The slopes are forested with a mesic hammock containing broad-leaved magnolia, laurel oak, some white oak, and scattered *Pinus glabra* with an understory of *Batodendron arboreum* and Florida dogwood. This merges with a more xeric vegetational association on the upper slopes. The sides of the ravine are not so precipitous

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as in the "Torreya Ravines" farther south in Liberty County, but there is obviously a very marked difference in local edaphic and climatic conditions within the ravines in contrast to the surrounding drier area.

According to Ferguson, *et al.* (1947), eight or nine small springs issue from fissures in the rocks along the bottom of the ravine. The rate of flow in May, 1946, was about 0.50 million gallons per day and the temperature 69° F. An analysis of the water (Ferguson *et. al.*, 1947) indicates that it is of unusual softness compared to other springs in Florida.

Part of the spring flow is diverted into a swimming pool at the bottom of the main ravine, and the area is designated as a county park. We saw little sign of recent use in June of 1954, however, and the pavilion and other "improvements" have fallen into disrepair.

Despite the extensive human intervention, much of the area appears to be in fairly natural condition. Above the swimming pool small streams flow from the springs through little valleys down to the main pool, and below the pool a small stream carries away the overflow. The area was intensively explored for water beetles during June of 1954 by the writer and Mr. Sulvester N. Brown. Twelve collections from specific minor habitats include over 450 individuals representing 55 species and 29 genera of the families Dytiscidae, Noteridae, Haliplidae, Hydrochidae, Hydrophilidae, and Limnebiidae. No Dryopidae or Elmidae were taken, but some must occur in the stream or spring runs. No Gyrinidae were seen in any of the situations investigated, which probably reflects the small size of most of the aquatic habitats available.

An attempt was made to recognize minor habitats of significance in the occurrence of aquatic beetles. In this we were only partially successful because of the often very complex interrelationship of water, vegetation, debris, types of bottom, rate of flow, and various micro-topographical features. The following outline of minor habitats is therefore partly theoretical, and derived in part from a subsequent analysis of the beetles present:

A. Lotic situations:
   1. Small sand-bottomed streams, flowing rapidly down fairly steep slopes; with alternating sand-bottomed portions, small cataracts, and pools with deposits of leaf drift and other debris
      a. In sand along margin of sand-bottomed portions (negative)

b. In and on debris in pools
c. In *Sphagnum* moss dangling in water (negative)

2. Small sand-bottomed stream with moderate rate of flow, below the spring-head area
   a. In sand along margin in sand-bottomed portions (negative)
   b. In and under margin where tiny undercut banks have developed
   c. In and on debris collected in backwaters
3. Seepage at base of slopes, with slight flow, usually through beds of *Sphagnum* and other aquatic mosses.

B. Lenitic or semi-lenitic situations:

1. Small pool, fed by seepage from base of slopes (at A-3). Pool fairly choked with *Ludwigia*, grasses, sedges, dead leaves, sticks, and other organic debris so that the water was only 1 to 3 inches deep over a very flocculent, odoriferous, bottom of organic material
2. Small pool with water up to 6 inches deep, and fairly clear of vegetation, but surrounded by *Typha* and other emergent plants. Partly fed from seepage, and partly from back-flow from swimming pool
3. Large pool formed by damming of spring flow. Water bluish and clear, similar to spring boils in area, but with only very slight flow through drain at center
   a. On surface (negative)
   b. Along sandy margins among emergent vegetation of *Typha*, grasses and sedges.

The distribution of the water beetles in these situations is presented in the following table:

DISTRIBUTION OF WATER BEETLES IN MINOR HABITATS AT GLEN JULIA SPRINGS

	Lotic			Lenitic		
	A-1	A-2	A-3	B-1	B-2	B-3
DYTISCIDAE						
Agabetes acuductus (Harris)				7	1	
Bidessus cf. affinis (Say)				1		
Bidessus lacustris (Say)				1		8
**Bidessus* n. sp. *cf. falli* Young				9	3	12
Bidessonotus inconspicuus (LeConte)				9	5	
Bidessonotus longovalis (Blatchley)				3		6
Bidessonotus pulicarius (Aubé)				1		2
Celina angustata Aubé?				1	1	
Copelatus caelatipennis Aubé?		1	1	5	3	
Copelatus glyphicus (Say)				1		
Coptotomus interrogatus obscurus Sharp				1	1	2
Desmopachria sp. *cf. grana* (LeConte)				2		
Graphoderus liberus (Say)				1	2	
Hydaticus bimarginatus (Say)		1	1	32	12	

DISTRIBUTION OF WATER BEETLES IN MINOR HABITATS AT GLEN JULIA SPRINGS—(Concluded)

	Lotic			Lenitic		
	A-1	A-2	A-3	B-1	B-2	B-3
Hydroporus blanchardi Sherman?		2				
Hydroporus brevicornis Fall			2	1	1	
**Hydroporus filiolus* Fall?			1			
Hydroporus lobatus Sharp		1				18
Hydroporus niger Say				2		
Hydroporus shermani Fall?		1				
**Hydroporus venustus* LeConte						1
**Hydroporus* n. sp. *cf. oblitus* Aubé			3			
Ilybius oblitus Sharp?				1		1
Laccophilus fasciatus Aubé				1		1
Laccophilus proximus Say				6		4
Matus ovatus blatchleyi Leech?					4	
Rantus calidus (Fabricius)	1			16	12	
Thermonectus basillaris (Harris)				4	2	
NOTERIDAE						
Hydrocanthus oblongus Sharp				1	2	
HALIPLIDAE						
Peltodytes spp.						9
HYDROCHIDAE						
Hydrochus minimus Blatchley?						1
Hydrochus foveatus Haldeman						3
Hydrochus rugosus Mulsant				2		2
HYDROPHILIDAE						
Berosus sp. *cf. striatus* Say					1	3
**Berosus pantherinus* LeConte						1
Crenitulus suturalis (LeConte)						1
Cymbiodyta blanchardi Horn?		4	3			
Cymbiodyta vindicata Fall?				1		
Enochrus cinctus (Say)		1	1	24	1	
Enochrus consors (LeConte)				2		
Enochrus ochraceus (Melsheimer)		2	9	4		1
Enochrus perplexus (LeConte)?				3		
Enochrus sublongus (Fall)		1	1	11		3
Helocombus bifidus (LeConte)				6		
Hydrobius tumidus LeConte		1		4	1	1
Hydrochara sp.?			1	3	1	1
Neohydrophilus castus (Say)				1		
Paracymus subcupreus (Say)		2		60		9
Tropisternus blatchleyi D'Orchymont				14	8	3
Tropisternus natator D'Orchymont?				5	4	
Tropisternus lateralis nimbatus (Say)				2		1
Tropisternus mexicanus striolatus (LeConte)				3	4	
LIMNEBIIDAE						
Hydraena marginicollis Kiesenwetter				2		

* New Florida records.

It is evident from the table that certain species are restricted to recognizable subdivisions of the major habitat. A comparison of the lists shows most of these restrictions quite clearly:

A-1 represents the extreme headwaters of a small spring-fed stream. The rate of flow and instability of the bottom are probably limiting factors. With the exception of the Dryopidae and Elmidae, water beetles are not well adapted to maintain position in such situations. The occurrence of *Rantus calidus* merely reflects the abundance of this highly vagile species in a nearby habitat.

A-2 represents a type of small stream typical of the region around Chattahoochee. The source of water seems to be less important than the bottom which is composed of shifting, micaceous sands. Along the banks of such a stream lateral seepage is usually extensively developed, and probably represent the actual breeding places of the typical beetles. In the streams themselves the principal concentrations of beetles are found along or under banks which have been undercut by the stream action or in small collections of debris. These concentrations may result from a sort of trapping action of current and shifting bottom, the fauna being constantly replenished from the seeps.

Hydroporus blanchardi? and *Cymbiodyta blanchardi?* are the only abundant species characteristic of such situations in this region. The small "burrowing" water beetles, such as *Hydroporus vittatipennis,* seldom extend up into these small lateral streams, but are more strictly confined to the sandy margins of the larger rivers, spring runs, and lower streams. *H. shermani* (of which Floridian specimens are doubtfully representative) may also occupy seepages along streams, but the occurrence of this species farther north seems to be largely correlated with larger silty bottomed streams with marginal vegetation. The remaining species listed can probably be ignored as having been washed out of other habitats up stream.

A-3 represents one of several types of seepage areas found in northern Florida. In this particular situation, seepage issues from a steep bank and flows for only a very short distance into a small pool. The actual seepage resents a special minor habitat in which tiny rivulets of water trickle through various aquatic mosses over a bottom of organic debris. Such a situation would be perpetually cool (tending to be about the average temperature of the region) in both winter and summer. Despite the minute area which most similar seepages occupy, the general type of situation must be very extensively distributed because a number of groups of aquatic beetles are found almost anywhere that similar conditions occur. Important factors influencing water beetles seem to be the flow and relative coolness of the water together with the occurrence of mosses.

At Glen Julia Springs two very interesting species of the *oblitus* group of *Hydroporus* (*filiolus* and n. sp. *cf. oblitus*) were found in A-3. Both of these represent new records for Florida, and both may be new species. All of the members of this group which I have studied occur in springs or seepages with some notable exceptions in northern bogs and bog-like situations. The taxonomy is too confused at present to allow the clear separation of forms without very large series of specimens at hand. Nearly every isolated spring or seep seems to have a distinctive local population which could be separated from others on body shape, genitalia, punctation, coloration, or other characters. If these forms represent relicts of an ancient fauna such diversity would be expected, and the unravelling of their taxonomy will perhaps give us additional information on the probable geological history of the regions in which they occur.

Hydroporus brevicornis is another interesting species taken in the seepage and also in the pool below the seep (B-1). The general shape suggests that this insect is adapted to "burrowing" in unconsolidated organic material on the bottom. It is nearly always found in association with springs or seepages, and often where rheocrene springs flow out over peaty materials.

Among the other species taken in A-3 *Cymbiodyta blanchardi?* is probably characteristic of such situations as noted under A-2 above. *Enochrus ochraceus* occurs almost everywhere in the Eastern U. S. where detritus has accumulated in water so that its abundance is probably of little significance. The large predatory dytiscids in the pools below the seepage may have been responsible for reducing its numbers there. All of the remaining species must be considered accidental or at best sporadic inhibitants of seepages.

B-1 approaches a type of seepage often termed a "helocrene" spring, but combines features not usually found in such situations. Several minor habitats seem to have been telescoped upon one another. The great amount of living and dead vegetation present made part of the situation a veritable mosaic of small partitioned habitats. Some of these represent situations very similar to those found in true woods ponds to judge from the presence of characteristic woods pond beetles, such as: *Graphoderus liberus, Agabetes acuductus, Desmopachria grana* complex, *Ilybius oblitus?, Enochrus cinctus, Helocombus bifidus, Hydrochara* sp., and *Hydrobius tumidus.* Most of the other species present occur in a wide variety of types of habitats in Florida and elsewhere.

Agabetes acuductus could be observed at night resting at the surface of minute poolets among the dead leaves and organic debris, exactly as I have seen them do in woods ponds in southern Michigan. When disturbed they dived to the bottom and burrowed into the debris. All of the specimens collected are somewhat larger and darker than northern individuals, and the Florida population may represent a distinct subspecies. So far the species has been recorded only from Alachua County, Florida, south of the Appalachian mountains.

The concentration of hydrophilids, bidessids, and other small beetles in the seepage pool rather than in the more open pool adjacent to it, may again reflect the abundance of predatory forms. The large amount of vegetation and debris in B-1 probably furnished hiding places and protection for the smaller species.

B-2, the open pool, adjacent to and in part continuous with B-1, produced a much less diverse water beetle fauna. Only two species found there were not also found in B-1 (*Matus ovatus blatchleyi* and a species of the *Berosus striatus* complex). Many of the specimens taken in B-1 and particularly in B-2 had the corners of the pronotum or the tips of the elytra chewed off or were lacking parts of the antennae or legs. This was particularly true of the hydrophilids. No specific cases of attacks by one water beetle on another were observed, but it seems highly probable that the many individuals of *Hydaticus* and *Rantus* were responsible for this damage.

The composition of the collections from the empoundment of the spring water (B-3) was about what might be expected. Fish were present in the deeper portions, and nearly all beetles were taken from the margin among emergent plants. The most striking feature of this association was the lack of the large species of *Hydaticus, Rantus* and *Thermonectus,* together with the addition of haliplids (*Peltodytes* spp.) and two species of Hydrochidae.

The greater abundance of *Bidessus lacustris* in B-3 confirms what is now known concerning the occurrence of this species. It is characteristic of the edges of springs, streams, and ponds in this region where sandy or silty margins are present. The occurrence of a new species of *Bidessus* similar to *B. falli* is interesting. These tiny "burrowing" bidessids are apparently characteristic of the sandy or silty borders of clear water, usually flowing, throughout northern Florida, and apparently fill the niche of *Hydroporus mellitus*.

The total association from Glen Julia Springs reemphasizes the contrast between the Upland and Lowland water beetle faunas in Florida. The abundance of *Paracymus subcupreus* and the lack of *P. nanus* is striking. Another difference is evident in the species which occur in both types of situations. The specimens of *Matus ovatus blatchleyi* are larger and much lighter in color than specimens taken only a few miles to the south near Wilma in Liberty County, and the same applies to *Hydrocanthus oblongus* and *Coptotomus i. obscurus*.

The data presented here point up the difficulty of defining minor habitats or "niches écologiques" for aquatic beetles. A vast number of factors act upon the association of beetles in any particular situation. Some of these we can recognize in the field, such as: rate of flow of water, presence or absence of predators, presence or absence of organic debris, and the nature of the bottom. Other factors are either unrecognizable, except by instrumental analysis, or are very obscure in their operation. We seem a very long way from any precise definition of the definitive minor habitat except in most equivocal terms.

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